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ABOUT THE DESIGN POLICY

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Abstract

Referring to the previous attempts to systematize the field of design science in order to enable clear vision for the future this article advocates a need to rethink the complexity from a broader aspect. An appeal for a new approach introducing a need for the comprehensive design policy has been argued, although the policy of design research community has not yet being outlined. This article proposes a systems description of design policy and the process of its generation and implementation.

Keywords: engineering design, design science, design research, design policy

1 Introduction

Engineering designers share a common feeling that engineering is a noble calling that "community" should appreciate in its larger social and cultural context. This feeling is inspired by the recognition that all life systems are stakeholders of the technology that is developed y the engineers. Design is important element of many professions, and is central to engineering as well as to the fine arts, urban and regional planning, architecture and other disciplines. A large body of research on the design process exists in engineering and in several other fields. The role of the social and behavioural sciences in understanding, enhancing and developing a body of principles for design has been recognised in the recent research.

Generating knowledge about design and for design is the goal of discipline-oriented, scientific research of the design science community. This knowledge is the primary development force of the engineering design. Since the first works of Hansen, Roth and other pioneers of the field in the middle of the 20th century, the theoretical research into engineering design has grown into a field of significant complexity. Therefore, it is not "easy to see the trends of evolution, to identify the landmarks of development, to judge the scientific significance of the various approaches, and to decide on the target fields for investments". Orientation in the very fragmented and multi discipline-oriented research causes problems not only to new researchers but also to specialized experts due to the high segmentation and multi disciplinary aspects of the matter.

An alternative approach would be to rethink the complexity from broader level. Therefore this paper is not about a rigor academic research, nor about reporting scientific results. It is merely a speculation about the current momentum in the design community, an embryonic idea, sketching a possible new approach by introducing a need for the design policy. The focus will be given on the current situation brief, outlining the goals of the design research community during last few decades, emphasizing the need for comprehensive design policy. The policy of design research community has not yet been outlined. This article proposes a systems description of the design policy and the process of its generation and implementation. The lack of empirical evidence is obvious; therefore this paper should be viewed as a contribution to a hopefully further discussion.

2 The contemporary design research

The suitability of design theory and practice to meet global challenges of product development has been researched, practiced and thought by many groups and individuals. The recently published papers on the relevant design conferences (ICED series on the global level, DESIGN conferences in Dubrovnik, for instance, on the local level) manifest the scientific enhancement and increased research rigor. Horvath et al. in paper “Engineering design research: anno 2000” [1] advocates a need for a comprehensive but, at the same time, sufficiently articulated vision reflecting the current state-of-the-art in the design science and foresee ahead to the near future, recognizing improvement as “… enormous efforts have been and are being made towards scientific understanding, technological underpinning and practical exploitation of engineering design".

From the early days the design science has emerged from methodical design approach, which has demonstrated its value in particular case studies and education, to empirical studies of design theory and practice in nineties. Hubka and Eder [9] viewed “design science” as a comprehensive body of knowledge which consisting of four categories: theory of technical systems, design theory and theory of design processes, special technical information and applied knowledge from natural and human sciences, and design methodology/

One of the first general and multi-view surveys of the many streams of design research has was published by Finger and Dixon [2] over a decade ago. Since then a number of attempts to define the field of design research can be found in literature. On the other hand the attempts to consolidate the derived knowledge have been rather infrequent. Design and science have traditionally been viewed as separate fields, with the latter producing the knowledge on nature and the former using such knowledge to perform actions upon nature itself. Such a perspective is close to the Aristotelian distinction between “episteme” producing “theoria” and “techne” aiming at “poiesis” (i.e., producing new things). Modern students of technology [6, 7] have shown that, even if technology is indeed related to science, the technological knowledge is something different and richer than simply “applied scientific knowledge”. Other authors, such as Simon [8], suggested the development of a “science of design” as “a body of… analytic, partly formalizable, partly empirical, teachable doctrine about the design process”. Simon considered design broadly, as a process defining a course of action “aimed at changing existing situations into preferred ones”. Analyzing the relations between design, science and technology Cross [10] distinguished the following: “scientific design” (i.e., when design is a subject that uses scientific knowledge); the “science of design” (i.e., when design is viewed as a phenomenon and is a passive object of scientific analysis); and the “design science” (i.e., when one makes design happen in a scientific way through methods and tools, and design is an object to which scientific knowledge is applied).

Contemporary research yield to a long time covered issues of capability, quality and measure, involving key terms like validation and evaluation of the research methodology. Since ICED 95 n Prague a significant attempt of design community to increase research rigor could be notified. The last ICED in Glasgow intensively increased the rigor of reviewing process with preliminary review of abstracts and full blind review of full papers, introducing thus the reviewing practice common to the journals to the conference environment.

Bender at all. [13] analysing challenges in the current product development and the history of design methodology recalling the work of Beitz [11] from 1972 concludes: "At first glance little seems to have changed. Due to globalization and the increasing integration of the customer's viewpoint, some of the issues have become even more challenging and none of these has yet been solved satisfactory."

Horváth et al. [1] argued a need for "...a multi-level taxonomical framework in order to systematize the research aspects and approaches of engineering design".

Samuel and Lewis [14] opened discussion about the need for "formal study of the design activity in its various forms".

Engineering design is a distinguished discipline, but obviously with many dimensions, different classification systems, and machinery. The complexity of the subject requires a complex model to represent it. Unfortunately, the developed 'complex' models in order to be implemental in most application cases have been sacrificed to simplified view, tailored to the particular needs, and verified in a particular case study under investigation or application area. A common feature of different models of design process is that process is divided into design stages, not necessarily defined in a same manner, but in a linear, sequential manner. Yet such approach enables local optimization of each stage of the design process it does not necessarily leads to the optimised process as a whole. Additionally such approaches although verified in the application does not give ground for generalization and further research, yielding to many time mentioned duplication of design research.

Although there are no doubts about maturity and stability design research has reached in last six decades there is a general consensus that there is a wide space for improvements and broad assumptions on discrepancy between quantity, which is exemplified in a number of papers published literally every hour, and the content broth up, i.e. the quality.

3 The need for the design policy

It could be expected that a clear vision of the current state and future goals and directions in a highly unstructured field could be beneficial for both the community and individuals. Such a vision should be called the design policy. The policy of design research community has not yet been outlined. The policy should unify the diverse views that surfaced the contemporary research in design, design theory and methodology, articulating a unified body of knowledge about design process and designs. This attempt is, naturally, based upon the author's experiences and therefore by definition represents a single view. As such, it must be considered as preliminary subject of discussion, improvement and refinement as understanding develops.

Defining a policy is a speculative and highly hazardous goal. It is often the case that the consequences of "…policy decisions are rarely intended and even more rarely preferred by any one of the actors individually…." [12]. Before we explore the matter further we shall try to explain what we mean by a policy. Policy influences present and future activities of the others. The central question about every policy, including the design policy, would be how we can distinguish unsuccessful policy from unsuccessful implementation? The question is whether we can readily tell when the goals of the policy have been achieved. Additional questions that need an answer are whether we can tailor the design policies to the specific needs, thus making designing more effective, how we can recognize when we need new policies for new circumstances.

The most important feature of a policy is that it implies the authority to cause changes. Such changes inevitably initiate new relations among various functions of product development chain. At the core of the design policy we must recognize two distinct processes that could possibly be proposed: the first would be the design policy development and the second its implementation. Such a dualism is not a unique feature of a design process or product development process, as it occurs in many other domains under different names. In everyday politics the "policy generation process" is differentiated from political events. Control theories, for example, define a policy as "any rule for making decisions that yields an allowable set of actions". From the operations research viewpoint Keeney describes "fundamental" objectives addressing the central point of a decision and "means" objectives referring to approaches to achieving the fundamental objectives. Each of two named processes results with a different, significant output for the process. The Table 1 illustrates the above line of thought with the examples in different domains.

Table 1 Policy and implementation functions

Domain	***Policy Function***	***Implementation Function***
Business	Business area profit goals	Products and prices
Diplomacy	Political and economic objectives	Negotiations and treaties
Economics	Fiscal objectives	Monetary practice
Engineering	Mission objectives	System design
Medicine	Diagnosis	Treatment
Military	Theatres and objectives	Strategy and tactics
Religion	Dogma and creed	Liturgy
Science	Theories and Hypothesis	Analyses and experiments

The problem definition is of a crucial importance for the design process. The same holds for the policy change. A successful design policy function will therefore enable a set of directives (i.e. inputs to the implementation function) that will resolve the discrepancy between the states "as is" and "to be". More precisely, the design policy directives should establish the goals of the implementation function. A successful implementation function, oriented to the efficiency of the design process, could produce measurable and comparable effects. Inadequate policy or poor implementation will lead to undesirable results. Continuous failure in the implementation function will cause failure in the proposed design policy process, regardless of the quality of the design policy function. It is quite obvious that both aspects of design policy react to the results they cause, revealing the presence and feedback. "Feedback mechanisms … by continually responding to discrepancy between the system's actual and desired state adapt it to long-range fluctuations in the environment, without forecasting" [8]. The design process is not only engineering or technological phenomenon, it is a cultural and social issue, therefore, as in other social matters, a multiple, nested feedback loops should be expected as a constant events. Each loop provide adjustments on the local state level, but potentially influencing the system level. The feedback (in some terminology referred as evaluation output) is essential for the decision. In order to adjust decisions to unexpected occurrences, improved knowledge and changes is required. A possible bottleneck for the design policy implementation will be inertia, as in any complex system. The responses to initial policy directives could be misleading indication of the final outcome. Further policy can evolve without the policy makers, as in politics the policy makers have one way of imaging it that may not fully correspond to the view of those who carry it.

4 The impact of information flow

The policy process mainly depends on the information flow accuracy. Inaccurate information flow that is not capable of disseminating to the receiver the appropriate, relevant, up-to-date information will distort the perspective of the decision makers. In the design process the information flow is of particular importance, because most information designers collect in more or less informal ways. For instance March, as reported in [12], has found in a study in Rolls Royce that designers have gained 82% of their information from the people they knew and 9% from the people they did not know. Sources of the remaining 9% of information gathered in March's report were computers (3%), bookshelves (2%), filing cabinets (2%), desks (1%), and drawing vaults (1%). These results suggest that information flow is not smooth or fail-safe or restricted to formal channels, or even deliberate communication; it is often chaotic and cannot be predicted in all its aspects.

From the policy makers' viewpoint tracking the information flow in detail through the design process will be both inefficient and unnecessary for guiding the management of design communication. Manifestations of communication breakdown are manifold. In the research presented at ICED 01 [12] manifestations of inadequate information flows have been grouped under three problem headings: misunderstanding of the system as a whole; missing information provision; and information distortion.

The first problem group arises from the fact that product development activities are programmed and coordinated on the higher level then the individuals and teams that are performing actual processes, ''…resulting in lack of awareness of interactions between components of designs and between design processes''. Further insight recognized that team members were not aware of the requirements of other designers and, therefore, failed to do tasks due to the lack of knowledge where items of information, such as specifications and parameter values, come from. Backtrack of the information path is especially difficult across organizational barriers. The forward information flow is also unknown, therefore, design team members often do not know who depends on the information that they are creating, nor how they use this information. The lack of awareness of changes to the processes is more dangerous.

The second group of problems arises from the simple fact that designers are not told what they need to know on time. Information is rarely not provided at all. More often the information is provided ''naked'' without context, feedback, status, decision constraints and backtrack reasoning. The simplest but not less dangerous inadequate information flow is withholding the information through the supply chain.

Information distortion is often the result of a long information flow that involves several other people before it reaches the recipient. In the process of transmission, information is oversimplified, distorted by chained misinterpretation due to hierarchical informational paths between organizational units. Such a distortion could be the result of intermediary.

Everything in the design process, as well as in the policy process, depends on the accuracy of perceived information feedback on the policy and implementation functions. Simon observes that "because of the possible destabilizing effects of taking inaccurate predictive data too seriously, sometimes it is advantageous to omit prediction entirely, relying wholly on feedback, unless the quality of prediction is high." The fact is that all data and information available to policy and decision makers come from observation functions. The data are filtered and "they cannot see the actual state of the affairs". Even with good information, policy assessment can be misleading due to the fact that policy is rarely defined in explicit formulation. Contemporary management practices manifest such behavior. There is a tendency on the part of top managers to keep many and varied information channels, to focus on a limited number of issues (ignoring the rest) and practice the art of imprecision.

Assuming that policy ends with the "policy function" can not be a sufficient approach because it ignores the "real word" implementation issues. Such a policy that does not care on a feedback will likely fail to fulfil its objectives.

Any attempt to define a future design policy should:

- demonstrate a differentiation between policy activities according to purpose and the information content;
- define the forward and backward information paths;
- demonstrate a role of policy paradigm as a main policy driver;
- demonstrate the underlying unity devoted to the product development process;
- show resistance to atypical inputs, providing a mean to evaluate arbitrary action of the actors.

Therefore, the building brick of the design policy should be the interrelationships between policy and implementation information. The reference viewpoint mechanism is essential tool for the future design policy makers. It should enable an insight into the imposed constraints and acceptability to pre-existing policies.

Design policy process interactions can occur between the policy, implementation and strategy functions across all the elements involved in the product development process. Among the most interesting features of the design policy assessment is that the implementation function and strategy function overlap.

In the end it should be noted that the policy model generates the strategic guidelines for the implementation function. Further, a strategy helps to prioritize the functions and actions guiding in desirable directions.

5 The Design policy function

It was stressed out that the design policy should unify the diverse views presented in past and contemporary research in design articulating a unified body of knowledge about design process and designs. What are then the issues that should be addressed? Any attempt to answer on this question in the best case could be incomplete and not definitive since there is no definitive formulation of the problem and we are in fact dealing with the ill defined problem. From this it seems acceptable that the problem should be explored further and the requirements and appropriate solutions should be defined in an ongoing activity. However two areas demand particular care, the education and research. Education presumes the theoretical ground for educational curriculum, while research had not yet answered that request, but needs measure and system of quality. In both domains there are complex issues that should be considered like:

- Values, ethic and precautionary; *How do we relate to common human values and ethics, cultural differences and precautionary principle.*

- Know-How; *Including scientific and practical knowledge. Scientific knowledge includes theory addressing the key questions: What is the design theory? How do we measure the reliability of theory? The practical knowledge includes procedures, methods, process, algorithms, skills, approaches to problems and everyday technique including software. How do we measure and evaluate the achievements. The management of engineering knowledge already is or soon will become the most* *important strategic issue of further development at all levels: personal, company and society.*

- Methodology and paradigms; *should address the implementation issues, the boundaries between the activities, evaluation techniques.*
- Cognition; *Including the experience and aesthetic as well as subjective human activities that appear "beyond" analysis.*
- Organization and system; *including organised structures, the mechanisms and management and control, the integrative (administration) processes and organizations, communication infrastructure including the organizational model, the vocabularies, the product development process items definitions and means of communication that can link the stakeholders.*
- Power; *The ability to make operational ones regarding deployment of research, education and other matters of interest to participants.*

Any discussion about the design policy, besides professional engineering and design paradigms must address a complex and multidimensional legal, regulatory, ethical and social situation. In its roots, the basic idea behind the Design Society is multi- -cultural, -ethical and -professional association (a worldwide community) connecting individuals (and groups), practitioners, academics and educators to work together across the discipline boundaries. Therefore the Design Society could be the right environment and platform in and on the policy strategy function can be developed. It is reasonably to ask what should be the goals and how should the goals be prioritized.

6 Conclusion

Referring to the many previous attempts to systematize the field of design science in order to enable clear vision for the future we have tried to rethink the complexity from a broader level. An appeal for a new approach by introducing a need for the comprehensive design policy has been argued although the policy of design research community has not yet been outlined. This article proposes a systems description of design policy and the process of its generation and implementation.

This attempt is based upon the author's experience and therefore represents a single view. As such, it must be considered as preliminary subject of discussion, improvement and refinement as understanding develops. In other words "the conclusions can not be conclusive". Taking into account that in engineering the learning as going on is a "natural" behavior this is not necessarily a weakness.

As noted before this paper had not followed the rigorous scientific approach formulating a hypothesis that will be validated or disproved. The lack of empirical evidence is obvious; therefore this paper should be viewed as a contribution to further discussion.

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